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APPLICATION FOR LETTERS PATENT

TITLE: METHOD TO TRANSMIT AN INFORMATION
                 SERVICE IN A BROADCAST TRANSMISSION
                 SYSTEM

INVENTORS: Ralf SCHAEFER, Rudolf BITTNER

William S. Frommer
Registration No. 25,506
William S. Frommer
Registration No. 34,930
FROMMER LAWRENCE & HAUG LLP
745 Fifth Avenue
New York, New York 10151
Tel. (212) 588-0800

Description

1   The present invention relates to the field of transmission protocols. More par-
ticularly, the present invention relates to a broadcast transmission protocol for
an information service, i.e. to a method to transmit an information service in a
broadcast transmission system.

5

The DAB Standard, "Radio broadcasting systems; Digital Audio Broadcasting
(DAB) to mobile, portable, and fixed receivers", ETSI, ETS 300 401, Mai 1997,
Second Edition is an international standard for implementing a digital broad-
cast system which supports transmission of a variety of information services

10   from a sender side to an arbitrary number of receiver sides. Examples of said in-
formation services are audio stream applications, video stream applications, hy-
pertext applications, picture or text slideshow applications, newsticker applica-
tions, Java-based applications and the like.

15   With the availability of the up-coming DAB system, it is possible to realise an
information service, e.g. dedicated to the needs of a car driver. Such an informa-
tion service has to deal with some specific requirements. In comparison to a PC
a display and an input control can be assumed with limited capabilities. Infor-
mation must be accessible in a fast manner without long-lasting distraction of

20   the driver. Information should be presented in a unified way, so that control of
the system becomes intuitively soon.

Therewith, it is an object underlying the present invention to provide a method
to transmit an information service in a broadcast transmission system.

25

This object is solved by a method to transmit an information service in a broad-
cast transmission system according to claim 1. Preferred embodiments are de-
fined in the dependent claims 2 to 22.

30   According to the present invention a generic information service structure is as-
sumed and a method to transmit the information service from a server side to
an unlimited number of users over a broadcast medium is provided.

This transmission method comprises the following steps:
        - performing a fragmentation within each of categories representing said

1 information service to create data fragments,

   - adding signalling information to every data fragment, which signalling information allows a consistent reassembly of said data fragments at a receiver on basis of predefined protocol rules, to create respective broadcast objects,

5 and

   - transmitting said broadcast objects in an order according to an information content of said data fragment within said broadcast object.

Preferrably, said fragmentation is performed dependent on the information
10 content of the data to be transmitted.

Further preferrably, a broadcast object is classified in dependency on the information content of the data fragment carried within a broadcast object, and a repetition rate of transmitting a broadcast object is dependent on its type.
15

Still further preferrably, said fragmentation divides a category horizontally in at least two groups by building groups of item attributes of items of said category according to an importance of said item attributes.

20 Still further preferrably, said fragmentation divides at least parts of a category, in particular at least one group of the horizontally divided category, vertically by building groups of items of said category according to a logical membership of said items.

25 These general features of the present invention define the transmission of an information not dependent on the occurance or generation of said information, but dependent on its information content. Further, the information is not split only according to system requirements e.g. into transmission frames, but the information is divided also according to its information content.
30

Therewith, the possibility for a quick and satisfying reassembly of the information service at the receiver side is provided, in particular it is secured that a receiver receives and is able to reassemble the information according to its importance, i.e. acording to its information content. An advantage of this scheme is
35 that the importance of an information can be determined at the transmitter side which knows the whole information service and the most important information can be transmitted more often to secure that the provided information service

1 comprises an up to date content.

Further, it is an object underlying the present invention to provide a method to receive an information service in a broadcast transmission system and a re-

5 ceiver therefore.

This object is solved by a method to receive an information service in a broad-cast transmission system according to claim 23. Preferred embodiments are defined in the dependent claim 24 which refers back to claims 2 to 22. A re-

10 ceiver according to the present invention is defined in claim 24.

This reception method comprises the following steps:

　　　　- receiving broadcast objects;

　　　　- extracting signalling information and a data fragment of every received

15 broadcast object, which signalling information allows a consistent reassembly of said data fragments into an information category of said information service on basis of predefined protocol rules; and

　　　　- performing a defragmentation within each of categories representing said information service to create said information service.

20

Therefore, the present invention provides a transmission protocol for an information service based on a digital broadcast medium which is the first choice when information is to be provided to a large number of users. Information for all potential users is broadcast in a broadcast channel and a client filters

25 currently relevant information. The access time for a certain piece of information depends largely on the organisation of data in the broadcast channel which is advantageously defined according to the present invention.

The broadcast transmission protocol according to the present invention provides

30 means for a reliable transmission and for adequate access times. Reliable transmission includes prevention of data distortion and guaranteeing data consistency. Adequate access times are achieved by building chunks of information in a way which fits to the nature of a broadcast medium.

35 Organisation of data in an information system when used in a terminal is not suited for a broadcast transmission, because of its stationary use. Instead data to be broadcast gets amended by signalling information to guarantee reliable

1 transmission and organisation of data gets rearranged in order to achieve
   adequate access times.

   The present invention assumes a generic structure for an information service
5 and provides a method to transmit all information with a broadcast medium to a
   large number of users, thereby providing means for reliable transmission and
   adequate access times at start-up time and in case of information updates.

   The accompanying drawings, which are incorporated in and constitute a part of
10 this specification, illustrate embodiments of the invention and, together with a
   general description of the invention given above, and the detailed description of
   the embodiment given below, serve to explain the principles of the invention,
   wherein:

15 **Figure 1**   shows the generic information service structure according to an
                 embodiment of the present invention;

   Figure 2   depicts item information of an information category according to
                 the embodiment shown in Fig. 1;

   Figure 3   illustrates item information fragments within the information cate-
20   gory shown in Fig. 2;

   Figure 4   shows the structure of a service directory according to the embodi-
                 ment shown in Fig. 1;

   Figure 5   shows the structure of a category directory according to the em-
                 bodiment shown in Fig. 1;

25 **Figure 6**   shows the structure of an item directory according to the embodi-
                 ment shown in Fig. 1;

   Figure 7   shows the structure of an item dynamic data list according to the
                 embodiment shown in Fig. 1;

   Figure 8   shows the structure of an item main data list according to the em-
30   bodiment shown in Fig. 1;

   Figure 9   shows the structure of referenced attributes according to the em-
                 bodiment shown in Fig. 1;

   Figure 10 shows the structure of an item subset directory according to the
                 embodiment shown in Fig. 1; and

35 **Figure 11** shows the structure of an item subset according to the embodi-
                 ment shown in Fig. 1.

1　In the following a preferred embodiment of the invention is described by use of the accompanying figures. However, the invention is not limited to this specific embodiment which is an advantageous realization and shows in particular the rules for the transmission protocol, i.e. fragmentation to generate broadcast ob-

5　jects to be transmitted. Of course, the reception, i.e. defragmentation, needs to be performed according to rules corresponding to the rules for fragmentation to correctly rebuild the transmitted information service.

A table-oriented view is used to explain the basic idea of data fragmentation

10　(Figs. 2 and 3). All other illustrations show either the structure of service objects (Fig. 1) or broadcast objects (Figs. 4 - 9) by use of UML models (UML = Unified Modelling Language). UML is a standard for the design of object-oriented systems. Every object defines an entity, which consists of a set of attributes. For better readability some comments are inserted. The comments are surrounded

15　by "--" signs. Figs. 4 to 9 show each the structure of one broadcast object although illustrated by two associated entities.

Fig. 1 depicts the generic structure of an information service to be broadcast using the method of the present invention. It consists basically of three types of

20　service objects, which are Service, Category and Item. Every service object may have several attributes with several types and cardinalities. The relationship between Service, Category and Item is that the information service (Service) consists of one to many information categories (Category) and an information category has one to many items.

25

The Service object is the entry point for the service. It provides any information considered useful for the user when choosing a certain service among several others. Example attributes are a label (Name) indicating what information is provided by a service, a language (Language) information or which geographical

30　area (ServiceArea) is covered in case of a mobile information service. It depends on the information service which attributes should be provided here.

An information category (Category) is a container for one to many items. Besides linking all items of one category together it may provide some additional attrib-

35　utes like a label which indicates the content of the information category (Name) or an icon (Icon) to be used for the selection of an information category by the user. Again, it depends on the information service which attributes should be

1 provided here. Examples for categories are hotel information or sights.

An item (Item) carries most of the information the user is interested in. An example for an item is a hotel from an information category hotel information. All
5 items belonging to one information category share the same set of attributes, although it is possible that some parts are mandatory while others are optional. Examples for item attributes are a hotel name (Name), an address (Address), the total number of rooms (NoOfRooms), the currently available number of rooms (NoOfRoomsAvailable) or a picture of the item (Picture). Again, it depends on the
10 information service which attributes should be provided here. The set of item attributes is defined on a per category basis.

Fig. 2 shows the complete set of user relevant item information belonging to one category in a table. The example shows the hotel category. Every row contains
15 the data related to one hotel instance. Every column contains attribute values for all hotels.

DEFINITION OF BROADCAST OBJECTS: FRAGMENTATION

20 As the first step for broadcast transmission data fragments are defined. These data fragments are the basis for the creation of broadcast objects. Therefore a horizontal and vertical fragmentation scheme is applied as depicted in Fig. 3.

The horizontal fragmentation results in four groups of attributes. The Core Attributes group covers a very small set of the most important attributes, which
25 should be available in a terminal first on average. The Dynamic Attributes group covers all attributes, which are likely to change much more frequent than all the others. The Main Attributes group covers all remaining attributes and provides detailed information about an item. The fourth group of attributes is a special one. It consists of attributes belonging to one of the other three groups, which
30 are to be transmitted separately, e.g. large pictures, audio streams or video streams. A large picture e.g. could be an important feature for an information service, but due to the large bandwidth required it could be necessary to broadcast it with a very low repetition rate. Therefore the present invention provides a mechanism to broadcast such attributes in a separate manner. In the following
35 this group of attributes is called the Referenced Attributes Group. Referenced Attributes are still part of the respective group (Core, Main, Dynamic) as refe-

1   rences, but the data itself is transmitted as an additional broadcast object.

The vertical fragmentation results in item subsets of the complete set of category items. How many vertical fragments shall be used and which items are to be

5   assigned to a fragment depends on the application domain. An example is to divide the item set according to the geographical area. This might result in two subsets, one for local information and one for global information.

The vertical fragmentation scheme is applied on the Dynamic Attributes group

10 and the Main Attributes group. The Core Attributes group consists always of the complete set of all items. This leads to the following types of broadcast objects on a per category basis:

- Item Directory: The Item Directory contains the core attributes of all items.
- Item Dynamic Data List [1..N]: The Item Dynamic Data List[x] contains the

15   dynamic attributes of all items belonging to subset x.
- Item Main Data List [1..N]: The Item Main Data List[x] contains the main attributes of all items belonging to subset x.
- Referenced Attributes

20 Additional types of broadcast objects are:

- Category Directory: The Category Directory contains a complete list of all categories with all category attributes. It provides an overview about available categories. It exists only one object per service.
- Service Directory: The Service Directory object provides elementary informati-

25   on to get access to the information service. It may contain information useful for the user to decide if he wants to start the service or not. The Service Description object is the entry point to the service. It exists only one object per service.

30 The mechanism of Referenced Attributes can also easily be applied on the Category Directory and Service Directory.

DEFINITION OF BROADCAST OBJECTS: SIGNALLING INFORMATION

35 As the second step for broadcast transmission identified data fragments are amended by signalling information attributes in order to guarantee consistency when reassembling the fragments in the terminal after reception.

1   First of all every broadcast object has an Object ID. The Object ID consists of the Type attribute, the ID attribute and the Version attribute. The Type attribute identifies the type of the broadcast object, e.g. Service Directory, Category

5   Directory and so on. The ID attribute identifies uniquely a broadcast object of a certain type among other broadcast objects of a certain type. The Version attribute is used to indicate that a broadcast object is updated.

10   Fig. 4 depicts the structure of the Service Directory object. Besides the information service specific attributes Name, Language, ServiceArea and so on from the Service object, it provides the following signalling information:

- Object ID: The Object ID consists of the above mentioned attributes Type, ID and Version. The Type attribute identifies the broadcast object as a Service Directory.

15   - Protocol: The ProtocolVersion attribute is used by the receiving terminal to check protocol compatibility between the broadcast service and the processing unit in the terminal.

20   Fig. 5 depicts the structure of the Category Directory object. It consists of the Object ID, the NoOfCategories attribute and the Category Data.

- Object ID: The Object ID consists of the above mentioned attributes Type, ID and Version. The Type attribute identifies the broadcast object as a Category Directory.

- NoOfCategories: The NoOfCategories attribute indicates the number of categories the service consists of and how many Category Data attribute sets are

25   delivered with the Category Directory.

- Category Data: Every category is described by the attributes of Category Data. Besides information service specific attributes Name, Icon and so on from the Category object, it provides a Category ID. The Category ID consists

30   of an ID attribute, which uniquely identifies a category among other categories, and a Version attribute, which is used to indicate that a category is updated. Additionally the Category ID is used to link items together with their respective category.

35   Fig. 6 depicts the structure of the Item Directory object. It consists of the Object ID, the category linking information, the vertical fragmentation information, the NoOfItems attribute and the Item Core Data.

1 • Object ID: The Object ID consists of the above mentioned attributes Type, ID and Version. The Type attribute identifies the broadcast object as an Item Directory.

• Category ID: The category linking information specifies the category to which

5 the provided items belong.

• Vertical Fragmentation: Two attributes are provided which specify the number of subsets used to transmit the complete set of items of the respective category. The NoOfSubsetsMainData attribute indicates the number of subsets used for the Main Attributes group. This means that as many ItemMain-

10 DataList broadcast objects are transmitted as indicated by NoOfSubsetsMainData. The NoOfSubsetsDynamicData attribute indicates the number of subsets used for the Dynamic Attributes group. This means that as many ItemDynamicDataList broadcast objects are transmitted as indicated by NoOfSubsetsDynamicData.

15 • NoOfItems: The NoOfItems attribute indicates the number of items the respective category consists of and how many attribute sets Item Core Data are delivered with the Item Directory.

• Item Core Data: Every item is described by the attributes of Item Core Data. Besides information service specific attributes like Name and so on from the

20 Item object, it provides an Item ID. The Item ID consists of an ID attribute, which uniquely identifies an item among other items of the respective category, and three Version attributes, which are used to indicate that an item is updated. The CoreDataVersion attribute indicates changes of attributes in the Core Attribute group. All core attributes are delivered with the Item Di-

25 rectory. Additionally, the MainDataVersion and the DynamicDataVersion attributes are delivered. The MainDataVersion attribute indicates changes of attributes in the Main Attribute group. The DynamicDataVersion attribute indicates changes of attributes in the Dynamic Attribute group. All main attributes are delivered with ItemMainDataList objects and all dynamic attributes

30 are delivered with ItemDynamicDataList objects.

Fig. 7 depicts the structure of the Item Dynamic Data List object. It consists of the Object ID, the category linking information, the vertical fragmentation information, the attribute NoOfItems and the Item Dynamic Data.

35 • Object ID: The Object ID consists of the above mentioned attributes Type, ID and Version. The Type attribute identifies the broadcast object as an Item Dynamic Data List.

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1 • Category ID: The category linking information specifies the category to which the provided items belong.

• Vertical Fragmentation: The SubsetNo attribute indicates the number of the subset of items provided with current Item Dynamic Data List object. The

5 Item Directory object of the respective category contains the NoOfSubsetsDynamicData attribute, which indicates the total number of subsets.

• NoOfItems: The attribute NoOfItems indicates the number of items the current subset of the respective category consists of and how many attribute sets Item Dynamic Data are delivered with current Item Dynamic Data List

10 object.

• Item Dynamic Data: Every item is described by the attributes of Item Dynamic Data. Besides information service specific attributes like NoOfRoomsAvailable and so on from the Item object, it provides an Item ID. The Item ID consists of an ID attribute, which uniquely identifies an item among other

15 items of the respective category, and a Version attribute. The DynamicDataVersion attribute indicates that attributes in the Dynamic Attributes group of an item are updated.

Fig. 8 depicts the structure of the Item Main Data List object. It consists of the

20 Object ID, the category linking information, the vertical fragmentation information, the NoOfItems attribute and the Item Main Data.

• Object ID: The Object ID consists of the above mentioned attributes Type, ID and Version. The Type attribute identifies the broadcast object as an Item Main Data List.

25 • Category ID: The category linking information specifies the category to which the provided items belong.

• Vertical Fragmentation: The SubsetNo attribute indicates the number of the subset of items provided with current Item Main Data List object. The Item Directory object of the respective category contains the NoOfSubsetsMain-

30 Data attribute, which indicates the total number of subsets.

• NoOfItems: The attribute NoOfItems indicates the number of items the current subset of the respective category consists of and how many attribute sets Item Main Data are delivered with current Item Main Data List object.

• Item Main Data: Every item is described by the attributes of Item Main Data.

35 Besides information service specific attributes like Address, NoOfRooms, and so on from the Item object, it provides an Item ID and Referenced Attribute Picture. The Item ID consists of an ID attribute, which uniquely identifies an

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1   item among other items of the respective category, and a Version attribute.
     The MainDataVersion attribute indicates that attributes in the Main Attrib-
     utes group of an item are updated. The Referenced Attribute Picture is sup-
     ported by a reference to another broadcast object. The reference consists of
5   two attributes PictureID and PictureVersion. The PictureID corresponds to
     the ID attribute of the broadcast object (ReferencedAttribute) carrying the at-
     tribute value (picture data). The PictureVersion attribute identifies the latest
     version of the picture and corresponds to the Version attribute of the broad-
     cast object.

10

     Fig. 9 depicts the structure of the Referenced Attribute object. It consists of the
     Object ID and the referenced attribute.

     • Object ID: The Object ID consists of the above mentioned attributes Type, ID
       and Version. The Type attribute identifies the broadcast object as an Refer-
15   enced Attribute.

     • Referenced Attribute: This is the referenced attribute itself, e.g. the picture
       data in case of a referenced picture.

20   **ADDITIONAL PROTOCOL RULES**

     As the third step for broadcast transmission additional protocol rules are de-
     fined. The protocol rules in combination with signalling information allow con-
     sistent re-assembly of broadcast data.

25

     Broadcast Object Identification

     Objects transmitted in a broadcast channel can not be identified by the commu-
     nication state between sender and receiver as often done in bi-directional com-
30   munication environments. Instead every object must identify itself. Therefore
     three attributes are provided. Every broadcast object has a Type attribute, an ID
     attribute and a Version attribute. The Type attribute indicates the type of the
     broadcast object, which is used to apply the proper decoding scheme in the re-
     ceiving terminal. The ID attribute is used to distinguish several broadcast ob-
35   jects, which have the same type. The Version attribute indicates changes of a
     certain broadcast object. Thereby the receiving terminal can determine if the in-
     formation in the broadcast object is already known without decoding the whole

1   object.

Category Linking

5   A Category provides attributes describing the category itself and is a container
     for items of the respective category. In order to link a category together with its
     items the broadcast objects carrying item information have a CategoryID attrib-
     ute. The CategoryID attribute specifies uniquely an information category. All
     categories belonging to the service are transmitted with their attributes in the
10   CategoryDirectory. Thereby it is guaranteed that items can be linked together
     with their respective categories.

Referenced Attribute Versioning

15   Attributes of all three attributes group (Core, Main, Dynamic) can be transmit-
     ted as separate broadcast objects (Referenced Attributes). In this case the origi-
     nal location of the attribute uses a reference to the attribute. The reference con-
     sists of an ID and a version attribute. The ID corresponds to the ID of the
     broadcast object carrying the attribute. The version attribute corresponds to the
20   Version attribute of the broadcast object. In order to bring attribute reference
     and the attribute itself together in the terminal, these two attributes must be
     matched. This means ID and Version must have the same values.

     If a referenced attribute is to be updated, the Version attribute of the Refer-
25   enced Attribute object indicates an update (e.g. increment counter). In this case
     also the version of the attribute reference indicates an update. Additionally it is
     possible that not the referenced attribute changes its value, e.g. improved pic-
     ture, but that the reference changes. This means the referenced attribute is an-
     other ReferencedAttribute object. In this case the ID is exchanged and the ver-
30   sion information of the newly referenced attribute is used.

Item Versioning and horizontal fragmentation

     All item attributes of a certain category are grouped in three groups (horizontal
35   fragmentation): the Core Attributes group, the Main Attributes group and the
     Dynamic Attributes group. In order to indicate information updates each group
     has its own version attribute. The CoreDataVersion attribute is used for the

1 Core Attributes group, the MainDataVersion attribute is used for the Main At-
   tributes version and the DynamicDataVersion attribute is used for the Dynamic
   Attributes group.

5 All three attributes are sent together with the ItemDirectory, thereby providing a
   complete information about the latest version of an item. The MainDataVersion
   attribute is sent additionally with the ItemMainDataList object and indicates
   any changes in the Main Attributes group of an item. The DynamicDataVersion
   attribute is sent additionally with the ItemDynamicDataList object and indicates
10 any changes in the Dynamic Attributes group of an item.

   The protocol rule for item versioning is as follows:
   • Indicate an information update by use of the CoreDataVersion attribute (e.g.
     increment counter), whenever an item attribute value or an item attribute
15   cardinality of the Core Attributes group changes. This includes the case when
     with attribute referencing the reference is changed (Attribute ID) or the ver-
     sion of the referenced attribute is changed (Attribute Version).
   • Indicate an information update by use of the MainDataVersion attribute (e.g.
     increment counter), whenever an item attribute value or an item attribute
20   cardinality of the Main Attributes group changes. This includes the case
     when with attribute referencing the reference is changed (Attribute ID) or the
     version of the referenced attribute is changed (Attribute Version).
   • Indicate an information update by use of the DynamicDataVersion attribute
     (e.g. increment counter), whenever an item attribute value or an item attrib-
25   ute cardinality of the Dynamic Attributes group changes. This includes the
     case when with attribute referencing the reference is changed (Attribute ID)
     or the version of the referenced attribute is changed (Attribute Version).

   Vertical Fragmentation of Items
30

   The complete set of items belonging to a certain category can be divided in sev-
   eral subsets and transmitted as several broadcast objects. This can be used e.g.
   to decrease the impact of transmission errors or to provide different access
   times for different item subsets. The Item Directory indicates the number of
35 subsets used for the Main Attributes group and the Dynamic Attributes group
   respectively by use of NoOfSubsetsMainData and NoOfSubsetDynamicData at-
   tributes. The item subsets are carried with the ItemMainDataList and the Item-

1 DynamicDataList objects. These objects indicate by use of the SubsetNo attribute the number of the item subset provided by the current broadcast object. Additionally the NoOfItems attribute specifies how many items belong to the subset.

5 **Item Directory Versioning**

The Item Directory carries always a complete list of all items with their core attributes belonging to the respective category. The Version attribute of an Item Directory indicates an update (e.g. increment counter), when:

10
- the Item set changes:
  - Number of items changes: NoOfItems attribute changes.
  - Items are added: New items (ID attribute) are added to the Item Directory.
  - Items are removed: Items (ID attribute) are removed from the Item Directory.
15
  - Items are updated: Item version information (CoreDataVersion, MainDataVersion, DynamicDataVersion attributes) changes.
- or the vertical fragmentation changes: NoOfSubsetsMainData or NoOfSubsetsDynamicData attributes changes.

20 **Item Main Data List Versioning**

The Item Main Data List carries a subset of all items with their main attributes belonging to the respective category. The Version attribute of an Item Main Data List object indicates an update (e.g. increment counter), when:
25
- the Item subset changes:
  - Number of items belonging to the subset changes: NoOfItems attribute changes.
  - Items are added: New items (ID attribute) are added to the item subset.
30
  - Items are removed: Items (ID attribute) are removed from the item subset.
  - Items are updated: Item version information related to the Main Attributes group (MainDataVersion attributes) changes.
- or the vertical fragmentation changes: SubsetNo attribute changes.

35 **Item Dynamic Data List Versioning**

The Item Dynamic Data List carries a subset of all items with their dynamic at-

1   tributes belonging to the respective category. The Version attribute of an Item
Dynamic Data List object indicates an update (e.g. increment counter), when:

- the Item subset changes:
  - Number of items belonging to the subset changes: NoOfItems attribute
5   changes.
  - Items are added: New Items (ID attribute) are added to the item subset.
  - Items are removed: Items (ID attribute) are removed from the item subset.
  - Items are updated: Item version information related to the Dynamic At-
    tributes group (DynamicDataVersion attributes) changes.
10 • or the vertical fragmentation changes: SubsetNo attribute changes.

Category Versioning

All categories belonging to the service are transmitted with the Category Direc-
15 tory. A Category is identified by the ID attribute (Category Data). Updates to a
category are indicated by the Version attribute. The Version attribute indicates
an update (e.g. increment counter), when a category attribute value or a cate-
gory attribute cardinality changes. This includes changes resulting from attrib-
ute referencing.

20

Category Directory Versioning

The Category Directory carries always a complete list of all categories belonging
to the service. The Version attribute of the Category Directory indicates an up-
25 date (e.g. increment counter), when the Category set changes:

- Number of categories changes: NoOfCategories attribute changes.
- Categories are added: New categories (ID attribute) are added to the Category
  Directory.
- Categories are removed: Categories (ID attribute) are removed from the Cate-
30   gory Directory.
- Categories are updated: Category version information (Version attribute of
  Category Data) changes.

Service Directory Versioning

35

The Service Directory carries information relevant to the service as such. This
includes some attributes for a human user as well as a protocol information.

1　The ProtocolVersion attribute indicates changes to the transmission protocol,
e.g. data format changes or protocol rule changes.

The Version Attribute of the Service Directory changes, when the ProtocolVer-
5　sion attribute changes or at least one of the service attributes changes. This in-
cludes changes resulting from attribute referencing.

EXTENSION: EMBEDDING INFORMATION CATEGORIES IN A PREDEFINED
10　**FORMAT**

When realizing an information service it is likely that information from different
information sources is obtained. While in most cases it might be appropriate to
convert the original information structure of respective information source, this
cannot be assumed for all situations. The GATS protocol e.g. is used for delivery
15　of traffic incident messages to mobile phones. It uses an efficient, binary messa-
ge format. Each message consists of a mandatory and optional parts and requi-
res about 20 byte per traffic message on average. Applying a horizontal fragmen-
tation scheme might not be useful in this situation, because of the low band-
width requirement of a complete traffic message. Additionally, it might be unli-
20　kely that a content provider for traffic messages in the GATS protocol format
supports an information delivery according to described horizontal fragmentati-
on scheme. Therefore, the following part of the invention deals with the embed-
ding of an information category in a format, that should be preserved. The basic
assumption is that each item can be handled piece by piece as a whole. The in-
25　ternal structure of an item, e.g. its attributes or attribute cardinalities is not re-
levant for the broadcast transmission protocol described in the present inventi-
on. This leads to a solution in which only a vertical fragmentation scheme is
applied, but not a horizontal scheme. Additionally, the item data in a predefined
format is transmitted with an additional broadcast object, in order to enable dif-
30　ferent formats. To summarize this, two broadcast objects ItemSubsetDirectory
and ItemSubset are used to embed the information category.

Fig. 10 depicts the structure of the Item Subset Directory object. It is the
35　equivalent of the Item Directory object. It consists of the Object ID, the category
linking information, the NoOfItems attribute, the vertical fragmentation infor-
mation, and the Item Subset Data.

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1 • Object ID: The Object ID consists of the above mentioned attributes Type, ID
    and Version. The Type attribute identifies the broadcast object as an Item
    Subset Directory.

 • Category ID: The category linking information specifies the category to which
5   the provided items belong.

 • NoOfItems: The NoOfItems attribute indicates the total number of items the
    respective category consists of.

 • Vertical Fragmentation: The NoOfSubsets attribute indicates the number of
    subsets used for delivery of the complete set of items and how many attribute
10   sets Item Subset Data are delivered with current Item Subset Directory ob-
    ject. Additionally, this means that as many ItemSubset broadcast objects are
    transmitted as indicated by NoOfSubsets.

 • Item Subset Data: Every subset is described by the attributes of Item Subset
    Data. It provides two attributes SubsetID and SubsetVersion. The SubsetID
15   corresponds to the ID attribute of the broadcast object (Item Subset) carrying
    the subset data. The SubsetVersion attribute identifies the latest version of
    the subset data and corresponds to the Version attribute of the broadcast ob-
    ject.

20 Fig. 11 depicts the structure of the ItemSubset object. It consists of the Object
    ID, the category linking information, the vertical fragmentation information, the
    NoOfItems attribute and the Item Data:

 • Object ID: The Object ID consists of the above mentioned attributes Type, ID
    and Version. The Type attribute identifies the broadcast object as an Item
25   Subset.

 • Category ID: The category linking information specifies the category to which
    the provided items belong.

 • Vertical Fragmentation: The SubsetNo attribute indicates the number of the
    subset of items provided with current Item Subset object The Item Subset Di-
30   rectory object of the respective category contains the NoOfSubsets attribute,
    which indicates the total number of subsets.

 • NoOfItems: The attribute NoOfItems indicates the number of items the cur-
    rent subset of the respective category consists of and how many items are de-
    livered with current Item Subset object.

35 • Item Data: Every item is provided in a predefined format, which might differ
    from the format used for broadcast transmission protocol described in
    the present invention and which is not relevant for the protocol. The protocol

provides only a container, which carries this kind of data. It is assumed that every item has an ID attribute, which uniquely identifies an item among other items of the same category and a Version attribute that indicates changes to an item. Additional information provided for an item is not relevant for the present invention.

ADDITIONAL PROTOCOL RULES FOR EMBEDDING OF INFORMATION CATEGORY IN PREDEFINED FORMAT

The embedding of an information category in a predefined format follows basically the principles as described for the protocol without this extension, but some slight modifications are necessary.

Broadcast Object Identification

Same as before.

Category Linking

Same as before.

Item Versioning

No horizontal fragmentation is supported. Therefore only one version attribute for each item is required. All version attributes are sent with their respective items in a ItemSubset object.

The protocol rule for item versioning is as follows: Indicate an information update by use of the Version attribute (e.g. increment counter), whenever an item changes in accordance to the rules of the embedded information category.

Vertical Fragmentation of Items

The complete set of items belonging to a certain category can be divided in several subsets and transmitted as several broadcast objects. This can be used e.g. to decrease the impact of transmission errors or to provide different access times for different item subsets. The Item Subset Directory indicates the num-

1   ber of subsets used for the item set by use of the NoOfSubsets attribute. The item subsets are carried with ItemSubset objects. This object indicates by use of the SubsetNo attribute the number of the item subset provided by the current broadcast object. Additionally the NoOfItems attribute specifies how many items

5   belong to the subset.

Item Subset Directory Versioning

The Item Subset Directory carries always a complete list of all subsets carrying

10 items belonging to the respective category. The Version attribute of an Item Subset Directory indicates an update (e.g. increment counter), when:

- the Item subset organization changes:
  - Number of subsets changes: NoOfSubsets attribute changes.
  - Subsets are added: New subsets (SubsetID attribute) are added to the

15   Item Subset Directory.
  - Subsets are removed: Subsets (SubsetID attribute) are removed from the Item Subset Directory.
  - Subsets are updated: Subset version information (SubsetVersion attribute) changes.

20 • or the number of items belonging to the category changes: NoOfItems attribute changes.

Item Subset Versioning

25 The Item Subset carries a subset of all items belonging to the respective category. The Version attribute of an Item Subset object indicates an update (e.g. increment counter), when:

- the Item subset changes:
  - Number of items belonging to the subset changes: NoOfItems attribute

30   changes.
  - Items are added: New items (ID attribute) are added to the item subset.
  - Items are removed: Items (ID attribute) are removed from the item subset.
  - Items are updated: Item version information (Version attribute) changes.
- or the vertical fragmentation changes: SubsetNo attribute changes.

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Category Versioning

1   Same as before.

Category Directory Versioning

5   Same as before.

Service Directory Versioning

    Same as before.
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Although the present invention has been described by way of an information
service to be broadcast consisting of three types of service objects, an informa-
tion service to be broadcast according to the present invention may comprise
more or less types of service objects.
15

Further, it is described that the horizontal fragmentation results in four groups
of attributes. Of course, the horizontal fragmentation might result in more or
less groups of attributes. It is also possible that different information categories
comprise a different number of groups of attributes or that the general horizon-
20 tal fragmentation defines a certain number of attribute groups and one or more
groups of attributes are not present in one or more information categories.

Also, the vertical fragmentation is not restricted to the shown example, but can
be adapted according to the needs of the realized transmission system.
25

In case of more or less types of service objects, another number of groups of at-
tributes and/or another number of item sets (vertical fragmentation), of course,
the number and types of attribute objects will vary accordingly.

30 Furthermore, also the additional protocol rules which are shown and described
for the specific exemplary embodiment can be adapted accordingly.

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